

# Special Topics

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Injuries VII Special Topics  
Panel<sup>a</sup>

## Abstract

Concerning the past decade of war, three special topics were examined at the Extremity War Injuries VII Symposium. These topics included the implementation of tourniquets and their effect on decreasing mortality and the possibility of transitioning the lessons gained to the civilian sector. In addition, the training of surgeons for war as well as residents in a wartime environment was reviewed.

The Extremity War Injuries VII Symposium featured three special topics that have been especially important to military physicians who treat combat casualties, either as forward-deployed surgeons or while stationed at military medical centers. Forward-deployed surgeons found the universal distribution of, training in the use of, and early application of tourniquets for severe extremity trauma in the decade-long conflict to be important because the use of tourniquets significantly decreased mortality. For the lessons learned in casualty care to be passed on to the next group of surgeons, the training for deployed surgeons needs to be continually updated. Also important is the assurance that stateside medical treatment facilities that care for a large number of battlefield casualties have systems in place to ensure competent and balanced training for military residents.

## Tourniquets

In articulating lessons learned from early tourniquet use for control of prehospital hemorrhage, our intention was to translate these combat lessons for use in civilian trauma care. Presentations and ensuing discussions informed stakeholders of

the possibilities and practicalities of performance improvement opportunities.

When our nation's current war began, tourniquet use was as a means of last resort for hemorrhage control. One of the conflict's first US casualties exsanguinated from an isolated limb injury; no tourniquet was used. It appeared that "last resort" tourniquet usage meant, in practice, that the tourniquet was rarely or never applied. Soon, mounting evidence showed that delayed tourniquet application was often lethal. A concerted, comprehensive effort led to a change in tourniquet use—a change from a means of "last resort" to a means of first aid. This change remains one of the significant medical breakthroughs of the war. Estimates of tourniquet use have concluded that 1,000 to 2,000 US military service members' lives have been saved by the application of tourniquets during the current conflicts.<sup>1</sup> This estimate is based on an analysis of preventable deaths when no tourniquet was used compared with casualties who survived when a tourniquet was used.

The many lessons learned to date from the military trauma system have been published and translated into practical guidance in civilian textbooks and protocols. Many of

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the pearls and pitfalls—the “do’s and don’ts”—of tourniquet use are applicable in both military and civilian trauma. Civilian emergency medical system directors and stakeholders have participated in these developments and have, on occasion, led their cities and regions in implementing practical advancements in care. The incremental and progressive changes in policy, research, doctrine, training, and logistics over several years in the military have been followed in parallel fashion by civilians—with changes often made more quickly than were the original military changes. The discussion of these developments provided symposium attendees with knowledge of how to refine trauma systems in practical ways—what to do, when, where, why, and how. For example, differential tourniquet device performance

was evidenced so that the best device could be selected given the stakeholder’s clinical setting; the Emergency and Military Tourniquet (Delfi Medical Innovations, Vancouver, BC) was the most effective tourniquet recommended for civilian ambulances and paramedics.

One common mistake had been to view tourniquets as either good or bad. A better approach is to view tourniquets as devices that come with risks and benefits that are heavily influenced by training and the situation.

### Predeployment Training

Casualties in the current military conflict present with multifaceted injury patterns that are not routinely seen at military treatment facilities or

even at many civilian trauma centers. In addition to fractures, it is not uncommon for battlefield extremity injuries to have associated complex soft-tissue injuries, vascular injuries, and burns. The injured frequently present with comorbidities, including severe acute blood loss with ongoing massive resuscitation, hypothermia, coagulopathy, compartment syndrome, and extended prehospital tourniquet use. In an era of increasing surgical subspecialization, the deployable military orthopaedic surgeon needs to acquire and maintain a wide range of skills.

A 1998 General Accounting Office report identified a lack of valid training in trauma care for military medical personnel who practiced largely in military treatment facilities caring primarily for healthy, active-duty personnel and their dependents or re-

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tireses.<sup>2</sup> It was determined that military clinicians lacked suitable exposure to critically injured patients as a result of base closures and the privatization of the military medical system. The Deputy Assistant Secretary of Defense for Health Affairs designated proficiency in combat surgery training an “essential mission.” The report recommended the development of collaborative military and civilian training platforms at urban level I trauma centers to boost readiness.

In response to this mandate, the Joint Trauma Training Center was established at Ben Taub General Hospital in Houston, Texas, in 1999 to train military trauma teams. Subsequently, the Department of Defense closed the Ben Taub center but opened three service-specific trauma training sites. The US Air Force currently maintains the Center for Sustainment of Trauma and Readiness Skills (C-STARS) at the R Adams Cowley Shock Trauma Center at the University of Maryland, Baltimore, Maryland. Similar training is provided by the US Navy at the Navy Trauma Training Center (NTTC) located at the University of Southern California Medical Center, Los Angeles, California, and by the US Army through the US Army Trauma Training Center (ATTC) at the Ryder Trauma Center, Jackson Memorial Hospital, in Miami, Florida. The training provided at these centers combines didactic lectures, patient simulations, cadaver laboratories, mass-casualty exercises, and extensive clinical exposure, and uses components learned from both military and civilian healthcare systems. The premise of these military-civilian collaborations is to allow military clinicians from all of the service branches an opportunity to gain experience in the assessment and treatment of the critically injured in an urban, civilian environment before

deployment, as well as to maintain critical readiness skills.

These military and civilian partnerships enable the constant sharing of cutting-edge, evidence-based practice and have proved to be mutually beneficial. Students learn current state-of-the-art civilian concepts in trauma care, including damage-control surgery, advanced resuscitation techniques, and the trauma-systems approach to care. The civilian centers have the skills and assets of military permanent staff. These centers are also afforded the privileged opportunity to indirectly participate in the care of our injured soldiers by facilitating the introduction of the most recent advances in trauma and critical care to the battlefield. Additionally, these programs provide the military-embedded faculty opportunities to enhance their leadership, clinical, and teaching skills by providing didactic lectures, supervising students in the clinical setting, and evaluating students' skills within the operating room in patient-simulation laboratories and during mass-casualty simulations.

Critics argue that these courses emphasize civilian circumstances and that it is difficult to replicate the injuries experienced in theater or to transition the principles learned into military situations. Critics also argue that surgeons may be better trained by working in military facilities, where war-wounded casualties are cared for. However, a recent survey of deployed orthopaedic surgeons noted that many agreed that their predeployment training at an urban civilian hospital was beneficial: such training provided them with the confidence to tackle complex, orthopaedic injuries encountered while deployed.<sup>3</sup> They had the opportunity to apply the principles acquired during their training.

A possible solution to this issue would be to share predeployment

training between the civilian and military treatment facilities. However, this solution is possible only while casualties are being sustained, and it is likely that the current conflict will be drawing down soon. It is well recognized that, as the current conflicts draw to a close, these collaborative military and civilian training programs will become increasingly important to sustain the necessary critical skill sets within the Department of Defense. The professional relationship and exchange of ideas between civilian and military trauma surgeons help to improve clinical outcomes in the ongoing conflicts.

The spectrum of injuries seen, and the requisite skill set that the military orthopaedic surgeon must possess, are not adequately provided by military treatment facilities during peacetime. A military orthopaedic surgeon's level of readiness during humanitarian, peacekeeping, or combat operations varies and is directly affected by meaningful, high-quality training. Numerous assets are available to assist in the education and preparation of the deploying orthopaedic surgeon, including training handbooks, combat orthopaedic surgery textbooks, the Society of Military Orthopaedic Surgeons Disaster Preparedness and Trauma Care Toolbox, clinical practice guidelines, digital lectures, and consultation with subject matter experts. The current conflict has emphasized the necessity of maintaining competent clinicians trained with many different skill sets.

Several different future strategies were proposed to prepare current and future generations of orthopaedic surgeons for operating in conflict environments. These include an emphasis on clinical practice guidelines that are based on evidence-based medicine and clinical best practices, sustained use of military-civilian collaborations at urban trauma centers, more focused predeployment mili-

tary surgery training courses that include incorporation of time spent at level IV and level V military treatment facilities, use of advanced simulation techniques, continuing evolution of courses such as the Combat Extremity Surgical Course, and attendance at the Society of Military Orthopaedic Surgeons annual meeting. By using such a synergistic and collaborative approach, we can develop a standardized, measurable, and reproducible training program that will give the deploying orthopaedic surgeon the critical skills necessary to sustain the force and provide the best possible musculoskeletal care to injured military service members.

### Resident Education

The effects of a decade at war, in combination with the variability in attending faculty through deployments and assignment transfers, have made residency training in the military challenging. Since the beginning of hostilities in 2001, military facilities have experienced varying exposures to casualties requiring large resource utilization of operating room, resident, staff, and ancillary support services. Teaching staff surgeons in subspecialty positions either have been deployed forward to care for military members in Iraq and Afghanistan or have themselves left military service, resulting in variable exposure of residents to some areas of orthopaedic surgery.

It is the responsibility of the program director to assure that residents are trained adequately in all areas of orthopaedic surgery. The primary progress indicator that the program director has at hand is the resident case log system. This is a database provided by the Accreditation Council for Graduate Medical Education. However, to use this resource effec-

tively, residents must enter in all procedural encounters, and the program director must frequently evaluate the numbers and trends.

The surgical disciplines most significantly affected by the influx of casualties are those associated with a hospital overnight stay and therefore cannot be done at an outpatient surgery center. In the case logs, these are primarily the disciplines of adult reconstruction (eg, total joint arthroplasty), spine, and pediatric orthopaedic surgery. Residents graduating from programs heavily invested in acute casualty care have consistently been in the top 1% for cases directly attributable to war trauma (eg, amputations, débridement of open wounds, skin grafts, soft-tissue coverage/flaps). However, these residents have also consistently been in the bottom 10% for cases involving adult reconstruction and some areas of spine and pediatric orthopaedics. Disciplines that can be performed in outpatient surgery centers (eg, sports and shoulder, hand, foot and ankle) have not been affected to such an extent.

In August 2011, the Residency Review Committee for orthopaedic surgery published guidelines for minimum case numbers for 15 case types, encompassing all subspecialties.<sup>4</sup> National, program, and graduating resident averages and statistics are also made available each year. Once the current and future needs of residents are determined, the primary focus of each program must be on developing plans that will meet these needs. This is accomplished by adding physician extenders, such as physician assistants, in key areas (eg, on a trauma team, which requires extensive resources), by seeking rotations that will cover areas of need determined by the data available, and by being aware of the changes on the horizon.

Since 2003, with the changes to resident training brought about by

the 80-hour work week, many residency programs, including those of such groups and associations as the American Academy of Orthopaedic Surgeons, the Orthopaedic Residency Review Committee, the Council of Orthopaedic Residency Program Directors, and the American Board of Orthopaedic Surgery, have been examining strategies to improve resident education. The manner in which residents are educated as well as trained in technical skills is being further refined and evaluated. This includes theoretic as well as hands-on techniques, such as competency-based education and surgical simulators.

To further break down resident education in the light of duty-hour restrictions, three essential elements must be considered to ensure patient safety and high-quality care. These elements are capacity, commitment, and competence. Capacity is directly related to duty hours and fatigue. Commitment requires altruism and professionalism, which are discouraged by a shift-work orientation. Competence is essential for safe patient care; it must be remembered that, as duty hours are reduced to fight fatigue-related medical error, a certain amount of time is required to both acquire a knowledge base and attain proficiency in needed technical skills. Specifically, the concept of "deliberate practice" provides a foundation for a more efficient acquisition of surgical skills; deliberate practice is predicated on a repeatable process focused on selected components of a challenging task, provides immediate feedback, requires sustained concentration, and works at the margins of an individual's competencies. Until a competency-based educational system can be implemented, the profession (and our patients) would be well served by a heightened awareness of the need to optimize the educational value of the



available time and/or should consider requiring an increased number of years to achieve proficiency in the independent practice of medicine, especially when procedural competence is required. Such a realization will inevitably result in voluntary lengthening of some residency programs, particularly in surgical disciplines and in those medical specialties with a prominent procedural component.

Laboratory-based skills training and simulation are ways to optimize the available hours. Simulation has been used in many areas of industry but is at the beginning stages in medicine. The airline industry has been at the forefront of simulation for more than 40 years. In medicine, general surgical subspecialties have been the first to implement simulation training into the core curriculum, and it has recently become a requirement for all training programs.

Dedicated skills training encompasses several concepts, including cognitive knowledge, a performance assessment or pretest, training, a repeat assessment or posttest, and the

ability to repeat until mastery is achieved. Important portions of the training include skills coaching, observation of expert performance, dedicated practice, the opportunity to fail, and the ability to make errors in a safe setting that does not compromise patient outcomes.

Orthopaedic surgery at this time does not have a dedicated skills-training curriculum—but making a priority of an initiative to develop such a curriculum has been discussed. There will be a need to identify and develop skills-training modules that will support this new curriculum. In addition, subjective and objective assessment metrics will be necessary for these modules. As the modules are developed, assessed, and validated, it will become necessary to show that they improve performance, and they may play a role in certification and recertification in the future. Dedicated skills training has the potential to make the acquisition of skills more efficient and effective and, through resident practice prior to entering the operating room, to increase learning while enhancing patient safety.

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